Remarks

Claims 11-13, 15-25, 27, 37-38, and 40-65 are pending in the application. Claims 11, 15-18, 37, 44, and 53-56 have been amended. Claims 1-10, 26, and 28-36 were previously canceled. New claims 57-65 have been added. No new matter has been added by virtue of this response. Reconsideration of the application is requested.

Allowed claims

Applicant thanks the Examiner for the allowance of claims 44 and 52-56. Applicant also thanks the Examiner for the allowance of claims 11-25 if rewritten or amended to overcome the rejection under 35USC 112, first paragraph and for the allowance of claim 51 if rewritten in independent form.

Drawings

A new drawing, Figure 2, is attached showing an X-ray source for exposing a substrate, a stepper, and vibration insulation as requested by the Examiner. The drawing also shows the inline collimator/concentrator, stage, DVRTs, mask, gap, beam transport chamber, and helium.

Claim Objections

The Examiner objects to claim 51 because it claim the identical subject matter. However, applicant would respectfully ask the Examiner to consider that claim 51 depends on claim 43 which depends on claim 37. Claim 37 includes a limit not included in claim 44, namely "using an **inline** collimator or concentrator." Thus, claim 51 is different from claim 44. Thus, the objection has been traversed.

Claim Rejections--35 U.S.C. § 112

The Examiner rejects claims 11-25 under 35 U.S.C. § 112, first paragraph. Applicant has amended claim 11 as follows to include a source of radiation.

11. A method of exposing a resist on a substrate comprising the steps of:

a) providing the substrate with a film of resist;

b) placing the substrate on a stage;

c) sensing the position of the substrate with a displacement sensor, wherein said displacement sensor comprises a differential variable reluctance transducer (DVRT); and

d) providing a source of radiation, and exposing said resist with said radiation.

Thus, the rejection of claim 11, as amended, and claims dependent thereon has been traversed.

Claim Rejections--35 U.S.C. § 102(b)

The Examiner rejects claim 27 under 35 U.S.C. § 102(e), as being anticipated by Ohsaki. Claim 27 states:

27. A system for exposing a substrate comprising a stepper and an X ray source, vibration insulation **there between**.

Applicant would respectfully ask the Examiner to consider that Ohsaki discloses vibration damping **under the base plate** that supports the stepper "to isolate micro-vibrations action on the base plate (vibration isolation stand) of such devices from the installation floor at the micro-G level" (column 1, lines 22-25). Ohsaki further states that "vibration isolators are widely used **for the support of** precision instruments" (column 1, lines 34-36). Ohsaki also states, "in steppers, an XY-stage (wafer stage), which undergoes a large acceleration and deceleration, is mounted on a base plate held by vibration isolating pads" (column 1, lines 45-47).

Ohsaki thus, describes insulation and isolation **for the base plate** of the stepper. All of Ohsaki's insulation and isolation are provided between the stepper and the floor. None is provided between the X-ray source and the stepper. Ohsaki does not teach or suggest vibration insulation **between the X-ray source and the stepper** as provided in claim 27. It was the present applicants who first considered the idea of providing vibration insulation between the source and the stepper. Thus, claim 27 is clearly distinguished from the teachings of Ohsaki, and the rejection of claim 27 under 35 U.S.C. § 102(e), as being anticipated by Ohsaki has been traversed.

Claim Rejections--35 U.S.C. § 103(a)

The Examiner rejects claims 37, 38, and 40-41 under 35 U.S.C. § 103(a), as being unpatentable over Miyake. The Examiner states that "it would have been obvious . . . to substitute the collimator or concentrator with the parabolic mirror since it was known in the art that the parabolic mirror is used for collimate or concentrate the X-ray radiation and it appears that the invention would perform equally well with using one." Applicant understands the Examiner's statement to mean that it would have been obvious to replace the parabolic mirror of Miyake with the collimator or concentrator of the present invention and that Miyake would perform equally well with the collimator or concentrator of the present invention.

Claim 37 provides:

37. A method of exposing a resist on a substrate comprising the steps of:

a) providing the substrate with a film of resist;

b) placing the substrate on a stage;

c) providing x-ray radiation from a point source;

d) **using an inline collimator to collimate said x-ray radiation**;

e) providing a mask for defining exposure of said resist;

f) illuminating said mask with said x-ray radiation after said collimating step (d); and

g) exposing said resist with x-ray radiation passing through said mask.

Applicant would respectfully ask the Examiner to consider that Miyake describes a demagnification projection system that uses **all-reflection optics**, including parabolic mirror 103, reflective mask 104, and mirrors 105. Reflective mask 104 is larger than the image to be provided on substrate 106, and Miyake de-magnifies using mirrors 105 to provide the required smaller image on substrate 106.

The X-radiation Miyake uses must have a long enough wavelength to permit reasonably efficient reflection from each of Miyake's reflective optical elements, including reflective collimator 103, reflective mask 104, and reflective demagnifier 105. Since optical reflection is already required by mask 104 and demagnifier 105, Miyake is

working in a regime where optical reflection is practical, and thus, one of ordinary skill in the art would be motivated to use optical reflection for collimation as well, as taught by Miyake. For such longer wave length X-radiation, and even for light having even longer wavelengths, including ultraviolet and visible light, a parabolic mirror is superior to an inline collimator both for cost of the optical device and for efficiency of collimation (light out/light in).

By contrast, replacing parabolic mirror 103 with an inline collimator in Miyake's system would seriously degrade performance of the entire system since parabolic mirror 103 is more efficient at providing light output than an inline collimator would be. Because it would degrade performance of his system and add to its cost, it would not be obvious to replace parabolic mirror 103 with an inline collimator in the system described by Miyake.

For shorter x-ray wavelengths reflective optics no longer work because they actually absorb and attenuate the shorter wavelength X-radiation. Light having a wavelength below about 10 nm is absorbed by all known reflecting surfaces, and so Miyake's system appears to be designed for wavelengths greater than about 10 nm. For shorter wavelengths than 10nm none of the reflective optical components provided by Miyake work well since they would all absorb a substantial amount of the X-radiation. To operate with shorter wavelengths all of Miyake's optical elements would need to be replaced with optical elements that could pass the shorter wavelength. One could not just replace Miyake's parabolic mirror 103 with an an alternative, such as an inline collimator, one would also need to replace his reflective mask 104 and his reflective demagnifier stages 105, and further invention would be required to make all these changes and integrate them.

Applicant's system, by contrast, uses inline transmissive elements, including an **inline collimator,** as provided in claim 37, and is capable of working at wavelengths below about 10 nm. (The inline collimator of applicant's invention uses an optical device that involves glancing angle--less than about 2 degrees--to provide the transmissive inline collimation). Applicant found that an inline collimator is a solution to provide sufficient intensity at the substrate, even though an inline collimator is not as efficient as a parabolic mirror is at the longer wavelengths where reflective optics work. Thus, the rejection of claim 37, and claims dependent thereon, including claims 38 and 40-41 has been traversed.

The Examiner rejects claims 42, 43, and 45-50 under 35 U.S.C. § 103(a), as being unpatentable over Miyake as applied to claim 37 above and further in view of Hasegawa. Applicant would respectfully ask the Examiner to consider that neither Miyake nor Hasegawa, either individually or in combination, teach or suggest limit (d) of claim 37, from which claims 42, 43, and 45-50 depend: "using an **inline collimator** to collimate said x-ray radiation."

Further, claim 46 provides for "exposing said resist **at a time** when said displacement sensor output indicates that position of said mask with respect to said substrate is optimum." Neither Miyake nor Hasegawa, either individually or in combination, teach or suggest providing the exposure at the time when the position is optimum.

Further, claim 47 provides for "exposing said resist **at a time** when said displacement sensor output indicates that said gap is optimum." Neither Miyake nor Hasegawa, either individually or in combination, teach or suggest providing the exposure at the time when the gap is optimum.

Further, claim 49 provides for "using displacement sensor output to control substrate x, y, z, rotation, and magnification." Neither Miyake nor Hasegawa, either individually or in combination, teach or suggest providing other than Z axis control as described in Hasegawa. Neither teach or suggest rotation control for example. Furthermore, given the very different structure of Hasegawa it would not be obvious how to integrate his teachings into those of Miyake. Further invention would be needed.

It is believed that the claims are in condition for allowance. Therefore, applicant respectfully requests favorable reconsideration. If there are any questions please call applicant's attorney at 802 864-1575.

Respectfully submitted,
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